PRELIMINARY INVESTIGATION INTO THE STRIDULATORY MECHANISM OF *PLATYDERUS RUFICOLLIS* (MARSHAM) (COLEOPTERA: CARABIDAE)

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Abstract

The apparent stridulatory organ of the vertex and pronotum of *Platyderus ruficollis* is described. It is not thought to be a stridulatory warning mechanism, but it may be used for intraspecific functions. Alternatively, the beetle may be preadapted by having a mechanism that could be used for stridulation but not yet have evolved the movement necessary for forming a regular stridulatory organ. Again, it may be a vestige of former use in stridulation.

Platyderus ruficollis (Marsham) is found in open country under stones, prefering sandy or chalky soils. It has been recorded in almost two-thirds of the counties of England but does not seem to occur in Scotland or Wales (Moore 1957).

Dudich (1921) suggested that the vertex and pronotal regions of *P. ruficollis* are concerned with stridulation. Lindroth (1974) referred to the transverse granulae of the vertex as an apparent stridulatory organ.

According to Dumortier (1963) the cranioprothoracic method of stridulation is found only in the Coleoptera, where numerous examples are known. In different genera of Languriidae, Nitidulidae, Endomychidae, Hispidae, and Tenebrionidae the vertex has striated areas, which rub against the anterior margin of the pronotum through a vertical movement of the head.

Microscope observations of the vertex of both male and female specimens of *P. ruficollis* revealed the stridulatory surface. Microphotographs of the vertex (Figs. 1-2) show transverse rows of granulae with "pegs" projecting away from the pronotal region. This area of the vertex would be considered as the *pars stridens*.

The edge of the pronotum (Fig. 4) is tapered to form a thin plectron-like projection. This area can be easily flexed, appearing to have elastic properties. Microphotographs of the underside of this area reveal a transversely oriented, crenellated area (Fig. 3).

It therefore seems that the lower surface of the projecting leading edge of the pronotum (Fig. 3) may be used as a plectron in relation to the pars stridens of the vertex (Fig. 1) when the two undergo relative movement. The direction of the granulae of the vertex suggests a vertical movement of the head (Fig. 4).

Most carabids known to stridulate do so in response to some kind of external stimuli, possibly as a warning signal against predators (Thiele 1977). Stridulation is often accompanied by release of an acid secretion from the terminal abdominal glands (Forsyth 1972), thought to be a defensive discharge (Thiele 1977).

Fig. 1, Transverse granulae of vertex, showing projection pegs, of ***Platyderus ruficollis***. 20,000X.

Specimens of *P. ruficollis* were exposed to two kinds of stimuli, imitating those possibly experienced in their environment. Specimens were tapped to imitate pecking by birds, and blown upon gently to mimic the warm breath of foraging insectivorous mammals (see Linssen 1959). Generally, these stimuli cause carabids such as *Cychrus rostratus* (L.) or *Elaphrus cupreus* Dft. to stridulate immediately and release acid secretions from their abdominal glands (Linssen 1959; Bauer 1974). No such reactions could be induced in *P. ruficollis*. Also, no stridulatory movement between vertex and pronotum was observed during administration of the two stimuli.

Manually produced movement of the vertex against the pronotum produced no perceptible sound that could be interpreted as stridulatory.

Discussion

Stridulation by carabid beetles is thought to be used as a warning signal in response to disturbance by predators, and apart from agonistic behaviour it is not thought to be concerned with intraspecific communication, particularly as involved with sexual behaviour (Bauer 1973; Thiele 1977).

In *P. ruficollis* the mechanism described does not appear to be used as a warning mechanism, suggesting that perhaps it is used for intraspecific functions. To observe intraspecific communication, specimens of both sexes were kept for 3 months under laboratory conditions similar to those found in their environment. During this period no apparent sexual behaviour was noticed. If, in its natural environment, *P. ruficollis* uses the mechanism described for intraspecific communication other than agonistic behaviour, it would be the only carabid known to use stridulation to this effect. No other information appears to be available on any aspect of social behaviour in these beetles.

Alternatively, those carabid beetles investigated for stridulatory mechanisms seem to be well endowed with surfaces which could be used for stridulation. Different authors have suggested that in the genus *Elaphrus* Fabr. various areas of the elytra, abdomen, or wings may be concerned with stridulation (Forsythe 1978). Freitag and Lee (1972) listed 13 species of carabids and 62 species of tiger beetles with a pars stridens on the dorsal aspect of the costae and subcostae of both wings. However, many of these ground beetle species, such as *Loricera pilicornis* (F.), are not known to stridulate.

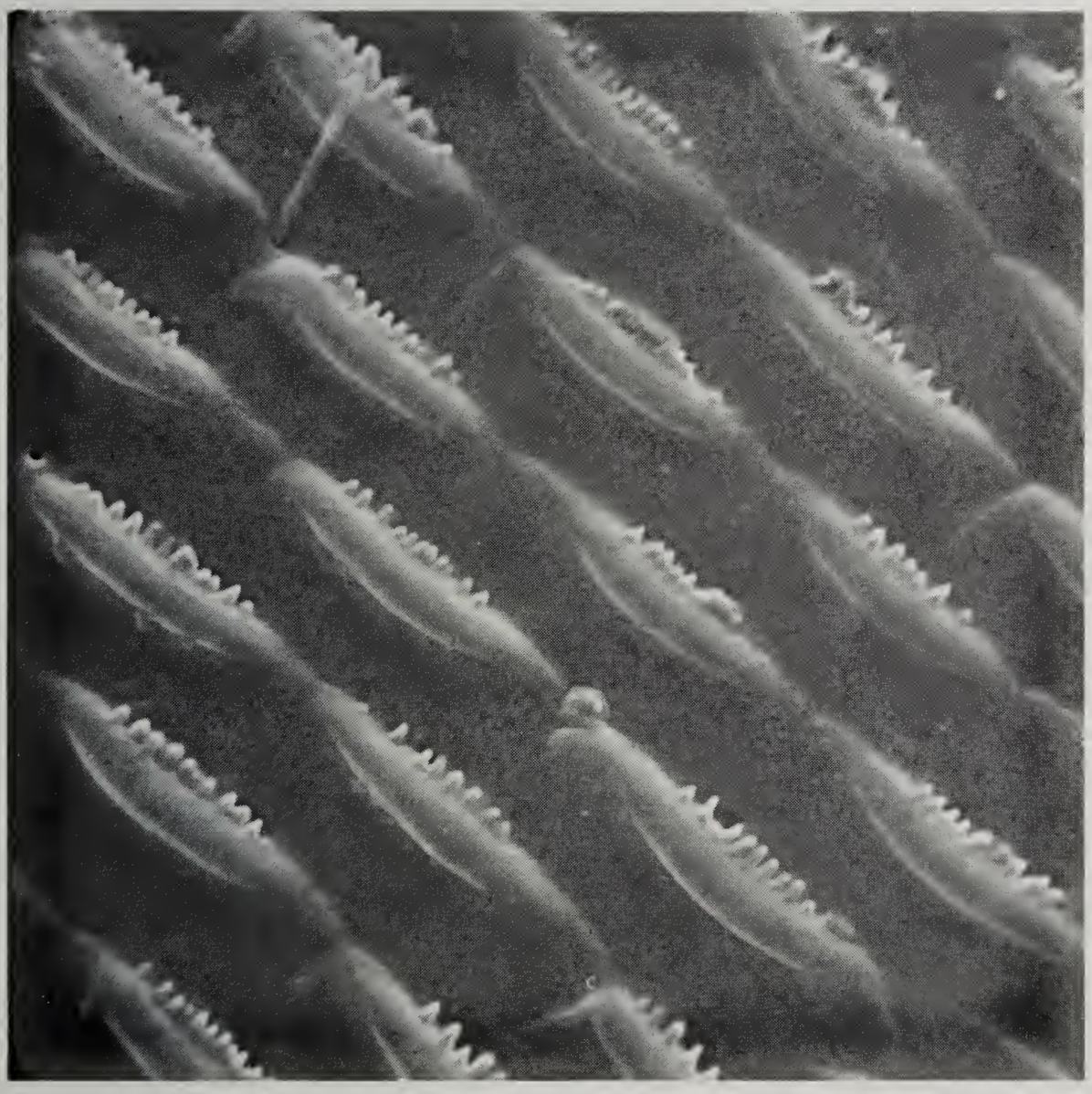

Fig. 2, Transverse granulae of vertex, showing projection pegs, of *Platyderus ruficollis*. 2000X.

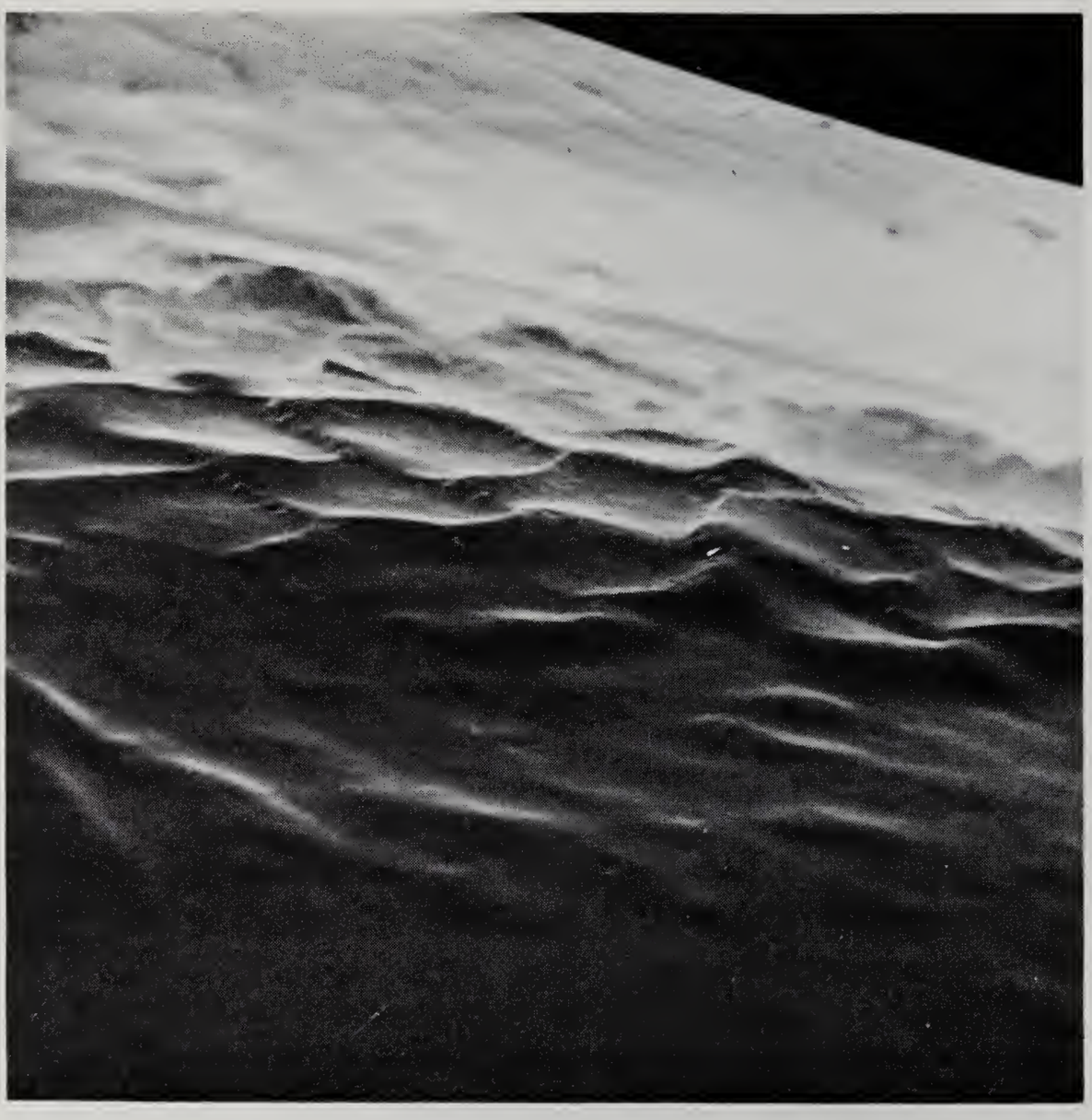

Fig. 3, Lower surface of leading edge of pronotum of *Platyderus ruficollis*. 1900X.

Claridge (1974) investigated the stridulation mechanism of *Cychrus caraboides* (L.) and found a number of surfaces, consisting of backward facing microlamellae on the abdominal projection and in the epipleural groove of the elytra thought to be concerned with stridulation. Similar surfaces found anterior to these at the base of the elytra could play no part in producing sound, since the base of the abdomen is fused with the mesothoracic and metathoracic segments which carry the elytra. He also investigated *Carabus problematicus* Hb., a species not known to stridulate, and found surfaces similar to those on *C. caraboides*. Microphotographs of the epipleural groove of the elytra and abdominal projection of *Blethisa multipunctata* (L.) reveal a similar arrangement of plectron-like structures in positions corresponding to those thought to be concerned with stridulation in *Elaphrus cupreus* (Forsythe 1978).

It therefore seems that it is not the presence of "stridulatory" surfaces that leads to stridulation, but the ability of the insect to adapt some movement which brings these surfaces together to produce sound. If the noise thus produced were in some way useful, the insect would gradually develop these surfaces, during evolution, into regular stridulating organs. Thus,

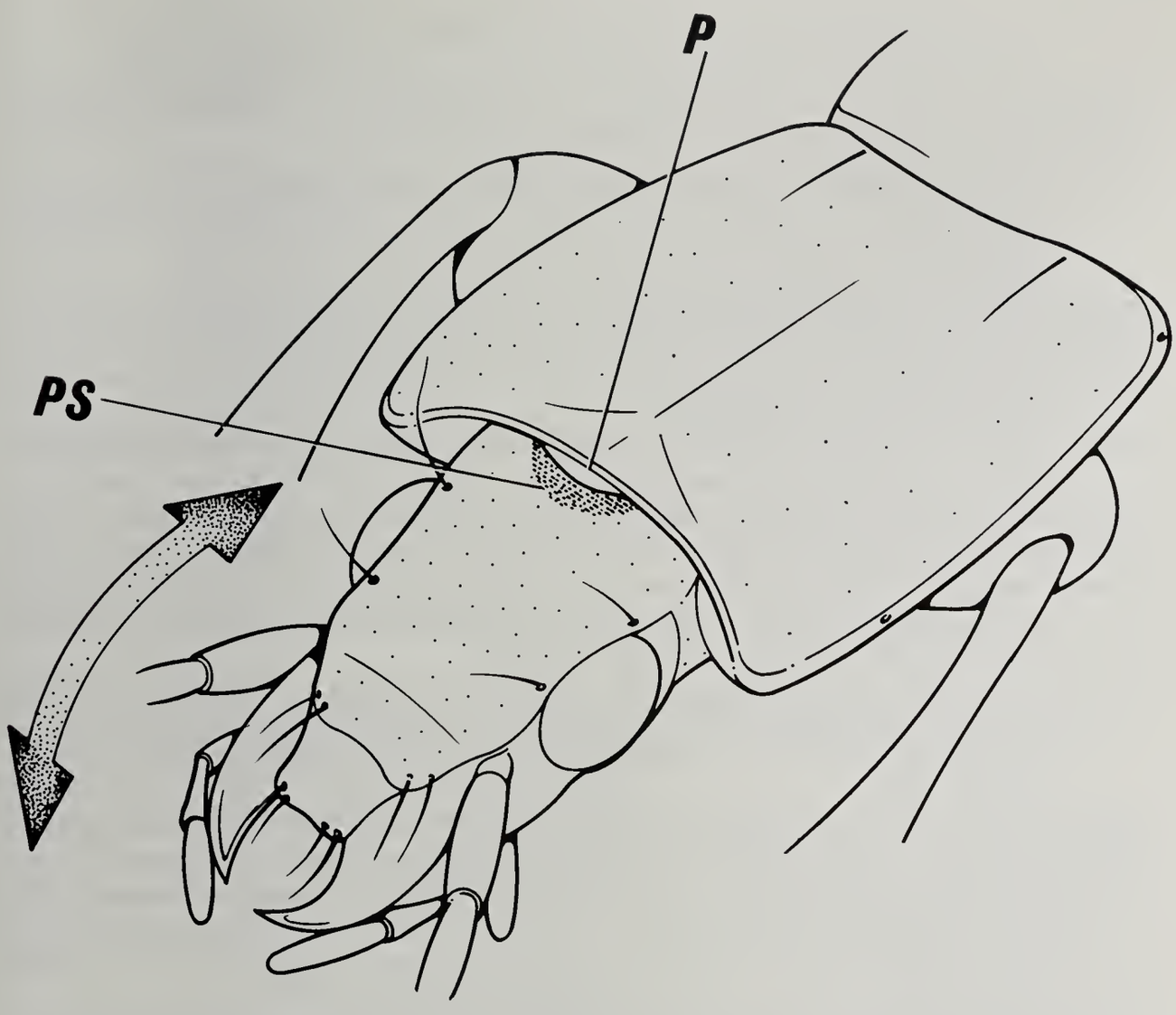

Fig. 4, Dorsal aspect of *Platyderus ruficollis,* showing the relationship between the pars stridens of vertex (PS) and leading edge of pronotum (P).

in *Elaphrus riparius* L., extension, retraction, and expansion of the abdomen during wing folding (personal field observations) may have become adapted for use in stridulation, the beetle being preadapted to stridulate by having "stridulatory" surfaces between elytra and abdomen. *Platyderus ruficollis* may be preadapted by having a mechanism which could be used for stridulation, but it does not appear to have evolved the movement necessary for bringing these surfaces together in such a way as to produce beneficial sound. On the other hand, the beetle as it adapted to a different or more specialised environment may have lost the ability to use the mechanism which remains as a vestige.

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Literature Cited

Bauer, T. 1973. Zur stridulation von Laufkäfern der Gattung *Elaphrus* Fabr. (Carabidae). Forma et functio 6:177-190.

Bauer, T. 1974. Ethologische, autökologische und ökophysiologische Untersuchungen an *Elaphrus cupreus* Dft. und *Elaphrus riparius* L. (Coleoptera: Carabidae). Zum Lebensformtyp des optisch jagenden Räubers unter den Laufkäfern. Oecologia 14(1-2):139-196.

Claridge, M. F. 1974. Stridulation and defensive behaviour in the ground beetle, *Cychrus caraboides* (L.). J. Ent. (A) 49(1):7-15.

Dudich, E. 1921. Beiträge zur Kenntnis der Stridulationsorgane der Käfer. 1. Ent. Blätter 17:145-155.

Dumortier, B. 1963. Morphology of sound emission apparatus in Arthropoda. *In* R. G. Busnel (ed.), Acoustic behaviour of animals. London.

Forsyth, D. J. 1972. The structure of the pygidial defence glands of Carabidae. Trans. Zool. Soc. Lond. 32:249-309.

Forsythe, T. G. 1978. Preliminary investigation into the stridulation mechanisms of the genus *Elaphrus* (Coleoptera: Carabidae): *Elaphrus cupreus* Dft. Coleopt. Bull. 32(1):41-46.

Freitag, R. and S. K. Lee. 1972. Sound producing structures in adult *Cicindela tranquebarica* (Coleoptera: Cicindelidae) including a list of tiger beetles and ground beetles with flight wing files. Can. Ent. 104:851-857.

Lindroth, C. H. 1974. Handbooks for the identification of British Insects. Coleoptera: Carabidae. Vol. IV, Part 2. Royal Ent. Soc. London.

Linssen, E. F. 1959. Beetles of the British Isles. Frederick Warne & Co., Ltd. London & New York.

Moore, B. P. 1957. The British Carabidae (Coleoptera) Part 2: The county distribution of the species. Ent. Gazette 8(3):171-180.

Thiele, H.-U. 1977. Carabid beetles in their environments. Springer-Verlag. Berlin, Heidelberg, and New York.

NOTICE

We have received word that one of our original members, Mr. William Rosenberg of Hazelwood, NC, died at his home on 23 August 1979. We have lost a good friend. We understand that some of Willi's collections will eventually come to the Smithsonian.